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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/837,007	04/18/2001	Mou-Shiung Lin	MEG 01-004	7677

28112 7590 03/23/2009

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EXAMINER	
ZARNEKE, DAVID A	
ART UNIT	**PAPER NUMBER**
2891	

MAIL DATE	DELIVERY MODE
03/23/2009	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	09/837,007	LIN ET AL.	
	Examiner	Art Unit	
	David A. Zarneke	2891	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *27 February 2009*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *55,57,58,60-62 and 66-80* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *55,57,58,60-62 and 66-80* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

Applicant's arguments, filed 2/27/09, with respect to the rejection of claims 55, 57, 58, 60-62 and 66-80 have been fully considered and are persuasive. Therefore, the final rejection has been withdrawn. However, upon further consideration, a new ground of rejection is made below.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 55, 57, 58, 60-62, and 66-80 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nozawa, US Patent 6,181,010.

Nozawa (figures 2 & 9) teaches a chip package; comprising:

a substrate [1000] having a first side and a second side opposite to said first side, wherein said substrate comprises multiple contact points at said second side (while not specifically teaching this, this is inherent to a circuit board, a circuit board is useless unless it can be interconnected to another substrate to form a device. Therefore, the circuit board [1000] must have multiple contact points on the second side)

a chip [100] over said first side of said substrate, wherein said chip comprises a silicon substrate;

a copper (4, 48+) pillar [22] between said first pad and a second metal pad of said multiple layers of interconnecting lines, wherein said metal pillar is connected to said second metal pad through an opening in said polymer layer, and wherein said copper pillar has a thickness between 10 and 100 micrometers (4, 50-57);

a solder metal [200] between said copper pillar and said first pad, wherein said solder metal is connected to said first pad; and

a layer [124] between said copper pillar and said solder metal.

Nozawa teaches the chip as having the a solder mask [106] at said first side, an interconnect covered by said solder mask and a first metal pad [104] comprising a region uncovered by said solder mask, wherein said first metal pad is connected to said interconnect; but fails to teach the substrate has these limitations.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use these limitations on the circuit board [1000] instead of on or in addition to the chip in the invention of Nozawa because it is conventionally known and used in

the art to form these layers on the substrate as opposed to the chip. A skilled artisan would know that these limitations could be used on the substrate instead of on the chip. The substitution of one known equivalent technique for another may be obvious even if the prior art does not expressly suggest the substitution (Ex parte Novak 16 USPQ 2d 2041 (BPAI 1989); In re Mostovych 144 USPQ 38 (CCPA 1964); In re Leshin 125 USPQ 416 (CCPA 1960); Graver Tank & Manufacturing Co. V. Linde Air Products Co. 85 USPQ 328 (USSC 1950).

Nozawa fails to teach the chip comprises multiple layers of interconnecting lines comprising copper, multiple insulating layers comprising an oxide material, multiple metal vias in said multiple insulating layers and between said multiple layers of interconnecting lines, wherein said multiple metal vias are connected to said multiple layers of interconnecting lines, and a polymer layer.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use the multiple layers in the invention of Nozawa because these are conventionally known in the art layers used to redistribute the pads on the chip. The use of conventional materials to perform their known functions is obvious (MPEP 2144.07).

Nozawa fails to teach a titanium-containing layer between said second pad and said metal pillar, wherein said under bump metal layer is on said second metal pad, on said polymer layer and in said opening in said polymer layer.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use a titanium containing layer in the invention of Nozawa because a

titanium containing layer is conventionally known in the art layer used as barrier layer or a wetting/adhesion layer on a pad, as evinced by Farnworth, US Patent 5,851,911 (2, 28-44). The use of conventional materials to perform their known functions is obvious (MPEP 2144.07).

Nozawa fails to teach the layer [124] is a nickel-containing layer.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use a nickel-containing layer in the invention of Nozawa because a nickel-containing layer is conventionally known in the art layer used as barrier layer or a wetting/adhesion layer, as evinced by Farnworth, US Patent 5,851,911 (2, 28-44). The use of conventional materials to perform their known functions is obvious (MPEP 2144.07).

Nozawa further fails to teach an underfill between said semiconductor device and said substrate, wherein said underfill contacts with said semiconductor device and said substrate and encloses said metal pillar and said solder metal.

It would have been obvious to one ordinary skill in the art at the time of the invention to use an underfill between said semiconductor device and said substrate because underfills are commonly known used by skilled artisans to protect and strengthen the package, as evinced by Farnworth, US Patent 5,851,911 (2, 1-5). The use of conventional materials to perform their known functions is obvious (MPEP 2144.07).

Regarding claim 70, Nozawa (figures 2 & 9) teaches a chip package; comprising:

a substrate [1000] having a first side and a second side opposite to said first side, wherein said substrate comprises multiple contact points at said second side, a solder mask [106] at said first side, an interconnect covered by said solder mask and a first metal pad [104] comprising a region uncovered by said solder mask, wherein said first metal pad is connected to said interconnect;

a chip [100] over said first side of said substrate, wherein said chip comprises a silicon substrate,

a copper (4, 48+) pillar [22] between said first pad and a second metal pad of said multiple layers of interconnecting lines, wherein said metal pillar is connected to said second metal pad through an opening in said polymer layer, and wherein said copper pillar has a thickness between 10 and 100 micrometers (4, 50-57);

a solder metal [200] between said copper pillar and said first pad, wherein said solder metal is connected to said first pad; and

a layer [124] between said copper pillar and said solder metal.

Nozawa fails to teach the chip comprises multiple layers of interconnecting lines comprising copper, multiple insulating layers comprising an oxide material, multiple metal vias in said multiple insulating layers and between said multiple layers of interconnecting lines, wherein said multiple metal vias are connected to said multiple layers of interconnecting lines, and a polymer layer.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use the multiple layers in the invention of Nozawa because these are conventionally known in the art layers used to redistribute the pads on the chip. The

use of conventional materials to perform their known functions is obvious (MPEP 2144.07).

Nozawa fails to teach an metal layer between said second pad and said metal pillar, wherein said metal layer is on said second metal pad, on said polymer layer and in said opening in said polymer layer.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use a metal layer in the invention of Nozawa because a metal layer is conventionally known in the art layer used as barrier layer or a wetting/adhesion layer on a pad. The use of conventional materials to perform their known functions is obvious (MPEP 2144.07).

Nozawa further fails to teach an underfill between said semiconductor device and said substrate, wherein said underfill contacts with said semiconductor device and said substrate and encloses said metal pillar and said solder metal.

It would have been obvious to one ordinary skill in the art at the time of the invention to use an underfill between said semiconductor device and said substrate because underfills are commonly known used by skilled artisans to protect and strengthen the package. The use of conventional materials to perform their known functions is obvious (MPEP 2144.07).

Regarding claim 57, Nozawa teaches said substrate further comprises multiple third pads (figure 9 shows multiple pads) uncovered by said solder mask, wherein said solder mask is separate from said first metal pad and from said multiple third metal pads, and wherein said first pad and said multiple third metal pads are aligned in a

direction parallel with a sidewall of said solder mask, wherein said first metal pad is connected to said interconnect through said sidewall.

With respect to claim 58, Nozawa teaches said copper pillar has a first sidewall recessed from a second sidewall of said nickel-containing layer (figure 2), but fails to teach a distance between said first sidewall and said second sidewall is greater than 0.2 micrometers.

It would have been obvious to one ordinary skill in the art at the time of the invention to optimize the distance to be greater than 0.2 micrometers through routine experimentation (MPEP 2144.05).

In re claims 60 and 72, while Nozawa, which teaches a circuit board (PCB) (8, 30+), fails to teach said substrate comprises a ball grid array substrate, it would have been obvious to one of ordinary skill in the art at the time of the invention to substitute a BGA for a PCB in the invention of Nozawa because BGAs and PCBs are known equivalent substrates to which semiconductor devices are attached. The substitution of one known equivalent technique for another may be obvious even if the prior art does not expressly suggest the substitution (Ex parte Novak 16 USPQ 2d 2041 (BPAI 1989); In re Mostovych 144 USPQ 38 (CCPA 1964); In re Leshin 125 USPQ 416 (CCPA 1960); Graver Tank & Manufacturing Co. V. Linde Air Products Co. 85 USPQ 328 (USSC 1950).

Regarding claims 61 and 73, while Nozawa fails to teach said multiple contact points comprise multiple contact balls at said second side, it would have been obvious to one of ordinary skill in the art at the time of the invention to use contact balls at said

second side in the invention of Nozawa because contact balls are conventionally used in order to attach the package to the next level of integration. The use of conventional materials to perform their known functions is obvious (MPEP 2144.07).

As to claims 62 and 74, though Nozawa fails to teach the first metal pad has a circular shape, the shape of the pad is an obvious matter of design choice. Design choices and changes of size are generally recognized as being within the level of ordinary skill in the art (MPEP 2144.04(I), (IVA) & (IVB)).

In re claims 66 and 75 , though Nozawa fails to teach said nickel-containing layer has a thickness between 1 and 10 micrometers, it would have been obvious to one ordinary skill in the art at the time of the invention to optimize the nickel-containing layer thickness through routine experimentation (MPEP 2144.05).

Regarding claim 67, though Nozawa fails to teach said titanium-containing layer comprises titanium nitride, it would have been obvious to one of ordinary skill in the art at the time of the invention to use titanium nitride in the invention of Nozawa because titanium nitride is a conventionally known in the art material used as a barrier layer. The use of conventional materials to perform their known functions is obvious (MPEP 2144.07).

As to claims 68 and 76, though Nozawa fails to teach said copper pillar is electroplated, it would have been obvious to one of ordinary skill in the art at the time of the invention to electroplate the copper pillar in the invention of Nozawa because electroplating is a conventionally known in the art method used to deposit copper. The

use of conventional materials to perform their known functions is obvious (MPEP 2144.07).

In re claim 71, Nozawa teaches metal layer [124] between said copper pillar and said solder metal, but fails to teach the layer is a nickel-containing layer.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use a nickel-containing layer in the invention of Nozawa because a nickel-containing layer is conventionally known in the art layer used as barrier layer or a wetting/adhesion layer. The use of conventional materials to perform their known functions is obvious (MPEP 2144.07).

Regarding claims 77-80, though Nozawa fails to teach said metal layer comprises titanium (claim 77), specifically titanium nitride (claim 78), or tungsten (claim 79) or tantalum (claim 80), it would have been obvious to one of ordinary skill in the art at the time of the invention to use a titanium nitride or tungsten or tantalum layer in the invention of Nozawa because a titanium nitride or tungsten or tantalum layer are conventionally known in the art layers used as barrier layer or a wetting/adhesion layer. The use of conventional materials to perform their known functions is obvious (MPEP 2144.07).

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP

§ 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to David A. Zarneke whose telephone number is (571)-272-1937. The examiner can normally be reached on M-Th 7:30 AM-6 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Sue Purvis can be reached on (571)-272-1236. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/David A. Zarneke/
Primary Examiner, Art Unit 2891
3/12/09